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Change-point regression models with unknown change-points: An application to Human papillomavirus (HPV)-associated cancer incidence in Canada

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The identification of trends, determination of the optimal number of change-points and their locations is important is when analyzing trend data. Very often, data exhibit non-linear trends over an entire study period but exhibit linear trends only within sub-intervals. Most methods used to characterize these segmented relationships are not appropriate because the change-points are either not considered at all (e.g. in polynomial regression) or are fixed a priori (e.g. regression splines). In addition, previous analyses of time series data detecting change-points were based on the assumption that change-points occur only at discrete grid points [Lerman, P. (1980). Fitting Segmented Regression Models by Grid Search. Journal of the Royal Statistical Society. Series C (Applied Statistics), 29(1),77-84.]. However, it is more lifelike that change-points can assume any value in the range of observed data and so are continuous. We fit a change-point linear regression model (made up of continuous linear segments) to determine the optimal number and ideal location(s) of the continuous change-points on the basis of a statistical criterion. We also determine the number of significant change-points through a serial permutation test using Monte Carlo simulation procedures. We maintained the global asymptotic significance of the resulting p-values through a Bonferroni correction. The change-point linear regression model is applied to national Human papillomavirus (HPV) - associated cancer incidence data in Canada from 1992-2013..

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